

What is claimed:

1. A method for the photocatalytic conversion of an oxygenated hydrocarbon into hydrogen comprising the steps of:

forming a suspension of an oxygenated hydrocarbon and a metal oxide semiconductor catalyst; and

irradiating the suspension with laser radiation in the range of 180nm to 520nm at a temperature of less than 70°C to thereby generate a high yield of hydrogen.

2. A method for the photocatalytic conversion of an oxygenated hydrocarbon according to claim 1 which includes the step of providing a semiconductor catalyst selected from the group consisting of nickel oxide (NiO), iron oxide (Fe<sub>2</sub>O<sub>3</sub>), zinc oxide (ZnO), tungsten oxide (WO<sub>3</sub>) and titanium oxide (TiO<sub>2</sub>).

3. A method for the photocatalytic conversion of an oxygenated hydrocarbon into hydrogen according to claim 2 in which the suspension is maintained at about 22°C.

4. A method for the photocatalytic conversion of an oxygenated hydrocarbon into hydrogen according to claim 3 in which the suspension is irradiated for a period of about 30 minutes.

5. A method for the photocatalytic conversion of methanol into hydrogen comprising the steps of:

providing a mass of methanol and a semiconductor catalyst;

forming a suspension of methanol and semiconductor catalyst; and

irradiating the suspension with laser radiation in the range of 180nm to about 520nm at a temperature at between about 10°C and about 70°C to generate a high yield of hydrogen.

6. A method of photocatalytic conversion of methanol into hydrogen according to claim 5 in which the suspension is irradiated with light having a wavelength of 355nm at room temperature.
7. A method of photocatalytic conversion of methanol into hydrogen according to claim 5 in which the suspension is heated to about 60°C.
8. A method of photocatalytic conversion of methanol into hydrogen according to claim 5 in which the semiconductor catalyst is selected from the group consisting of nickel oxide (NiO), iron oxide (Fe<sub>2</sub>O<sub>3</sub>), zinc oxide (ZnO), tungsten oxide (WO<sub>3</sub>) and titanium oxide (TiO<sub>2</sub>).
9. A method of photocatalytic conversion of methanol into hydrogen according to claim 8 in which the suspension is irradiated with illumination of about 150mJ per pulse laser radiation at a wavelength of about 355nm.
10. A method of photocatalytic conversion of methanol into hydrogen according to claim 9 in which the suspension is irradiated for a period of at least about 30 minutes.
11. A method of photocatalytic conversion of methanol into hydrogen according to claim 8 in which the suspension contains at least about 100mg of metal oxide catalyst per 50cm<sup>3</sup> of methanol.
12. A method for the photocatalytic conversion of methanol into hydrogen according to claim 11 in which the suspension contains about 500mg of WO<sub>3</sub> per 50mL of methanol and is irradiated with a high power laser beam of 355nm wavelength generated from a third harmonic of an Nd:YAG laser with an energy per pulse of between about 50 to 300mJ at about 22°C.
13. A method for the photocatalytic conversion of methanol into hydrogen according to claim 11 in which the suspension contains about 500mg of NiO<sub>2</sub> per 50mL of methanol and is irradiated with a high power laser beam of 355nm wavelength from a

third harmonic of an Nd:YAG laser with an energy per pulse of about 150mJ at room temperature.

14. A method of photocatalytic conversion of methanol into hydrogen according to claim 14 in which the suspension contains about 500mg of  $\text{Fe}_2\text{O}_3$  per 50mL of methanol and is irradiated with a high power laser beam of 355nm wavelength generated from a third harmonic of an Nd:YAG laser with an energy per pulse of about 150mJ at room temperature.

15. A method of photocatalytic conversion of methanol into hydrogen according to claim 11 in which the suspension contains about 500mg  $\text{TiO}_2$  per 50 mL of methanol and is irradiated with a high power laser beam of 355nm wavelength generated from a third harmonic of an Nd:YAG laser with an energy per pulse of about 150mJ at room temperature.

16. A method of photocatalytic conversion of methanol into hydrogen according to claim 11 in which the suspension contains about 500mg  $\text{ZnO}$  per 50mL of methanol and is irradiated with a high power laser beam of 355nm wavelength generated from a third harmonic of an Nd:YAG laser with an energy per pulse of about 150mJ at room temperature.

17. Apparatus for the production of hydrogen from an oxygenated hydrocarbon using a laser photocatalytic process, the apparatus comprising:

a closed cell including an inner and an outer portion with a window therein for receiving a mass of an oxygenated hydrocarbon liquid and a metal oxide semiconductor catalyst in powder form, a magnetic stirrer disposed in said inner portion and means for activating said magnetic stirrer disposed outside of said cell to form a colloidal suspension of the semiconductor powder in the liquid oxygenated hydrocarbon, a laser and optically aligned means for directing light from said laser through said window to thereby generate hydrogen and means for removing hydrogen from said cell.

18. Apparatus for the production of hydrogen from an oxygenated hydrocarbon according to claim 17 in which said optically aligned means for directing light from said laser through said window includes a third harmonic generator for providing light at 355nm.

19. Apparatus for the production of hydrogen from an oxygenated hydrocarbon according to claim 18 which includes a beam diameter controller.

20. Apparatus for the production of hydrogen from an oxygenated hydrocarbon according to claim 18 which includes a beam splitter and a mirror for directing the laser energy through said window and into said cell and an energy meter disposed behind said beam splitter.

21. Apparatus for the production of hydrogen from an oxygenated hydrocarbon according to claim 18 in which said cell includes an inlet valve, a liquid sampling valve and a gas sampling valve.

22. Apparatus for the production of hydrogen from an oxygenated hydrocarbon according to claim 18 in which said radiation from said laser is produced with a laser energy of between about 50 to 300mJ per pulse.

23. A method for the photocatalytic conversion of an oxygenated hydrocarbon according to claim 3 which includes the step of providing a methanol, ethanol or propanol.

24. A method for the photocatalytic conversion of an oxygenated hydrocarbon according to claim 23 which includes the step of controlling the laser radiation frequency to control the reaction process and yields from methanol, ethanol and other oxygenated hydrocarbons.